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REFERENCES

Ali, S. (1958) Notes on the Sarus Crane. Early 'imprinting' of vital commands. *J. Bombay Nat. Hist. Soc.* 55: 166–168.

Archibald, G.W. and Meine, C. D. (1996) Family Gruidae (Cranes). Pp. 60–89 in J. del Hoyo, A. Elliott and J. Sargatal, eds. *Handbook of the birds of the world. Vol. 3. Hoatzin to auks.* Barcelona: Lynx Edicions.

Breeden, S. and Breeden, B. (1982) The drought of 1979–1980 at the Keoladeo Ghana Sanctuary, Bharatpur, Rajasthan. *J. Bombay Nat. Hist. Soc.* 79: 1–37.

Calder, W. A. (1968) Nest sanitation: a possible factor in the water economy of the roadrunner. *Condor* 70:279.

Dell'omo, G., Alleva, E. and Carere, C. (1998) Parental recycling of nestling faeces in the common swift. *Anim. Behav.* 56: 631–637.

Ehrlich, P. R., Dobkin, D. S., Wheye, D. and Pimm, S. L. (1994) *The birdwatcher's handbook: a guide to the natural history of the birds of Britain and Europe.* Oxford: Oxford University Press.

Hurd, P. L., Weatherhead, P. J. and McRae, S. B. (1991) Parental consumption of nestling feces: good food or sound economics? *Anim. Behav.* 2: 69–76.

Kemal, R. E. and Rothstein, S. I. (1988) Mechanisms of avian egg recognition: adaptive responses to eggs with broken shells. *Anim. Behav.* 36: 175–183.

Littlefield, C. D. (1978) Behaviour of a pair of Sandhill Cranes on the day of nest destruction. *Condor* 80: 346–347.

Mallory, M. L., Rendell, W. B. and Robertson, R. J. (2000) Responses of birds to broken eggs in their nests. *Condor* 102: 673–675.

McGowan, K. J. (1995) A test of whether economy or nutrition determines fecal sac ingestion in nesting corvids. *Condor* 97: 50–56.

Morton, M. L. (1979) Fecal sac ingestion in the Mountain White-crowned Sparrow. *Condor* 81: 72–77.

Petit, K. E., Petit, L. J. and Petit, D. R. (1989) Fecal sac removal: do the pattern and distance of dispersal affect the chance of nest predation? *Condor* 91: 479–482.

Ramachandran, N. K. and Vijayan, V. S. (1994) Distribution and general ecology of the Sarus Crane (*Grus antigone*) in Keoladeo National Park, Bharatpur, Rajasthan. *J. Bombay Nat. Hist. Soc.* 91: 211–223.

Tinbergen, N., Broekhuysen, G. J., Feekes, F., Wroughton, J. C. W., Kruuk, H. and Szulc, E. (1963) Egg shell removal by the Black-headed Gull, *Larus ridibundus* L.: a behaviour component of camouflage. *Behav.* 19: 74–117.

Weatherhead, P. J. (1984) Fecal sac removal by Tree Swallows: the cost of cleanliness. *Condor* 86: 187–191.

Welty, J. C. and Baptista, L. (1988) *The life of birds.* New York: Saunders College.

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Surveys for Greater Adjutant *Leptoptilos dubius* in the Brahmaputra valley, Assam, India during 1994–1996

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The Greater Adjutant *Leptoptilos dubius* is considered to be globally threatened (Endangered: BirdLife International 2001). It formerly occurred in much of South and South-East Asia from Pakistan through northern India, Nepal and Bangladesh to Myanmar, Thailand, Laos, Vietnam and Cambodia. However, only two small and highly disjunct populations remain: in Assam and Cambodia (Rahmani *et al.* 1990, BirdLife International 2001). Prior to Rahmani (1989) and Saikia and Bhattacharjee (1989a, 1989b), there was little information about the status and distribution of Greater Adjutant in Assam. More recently, Bhattacharjee and Saikia (1996) presented information on the population size and trend between 1989 and 1994. This paper adds to these surveys, and reports on breeding season surveys in 1994–1995, and non-breeding surveys in 1996.

The study was confined to the Brahmaputra Valley, Assam (25°44′–27°55′N 89°41′–96°02′E). The valley is c.720 km long, c.80 km wide, covers 56,274 km^2, and is demarcated by the Eastern Himalaya, Patkai hills, Naga hills, Garo-Khasi-Jaintia hills and the Mikir hills (Singh 1991). The valley covers more than 60% of the area of Assam (Choudhury 1994). There are many river islands (including the 929 km^2 Majuli island: the largest river island in the world). Innumerable meandering tributaries form ox-bow lakes and huge marshy tracts.

METHODS

We surveyed Greater Adjutants in the Brahmaputra Valley during the breeding season in 1994–1995 (and occasionally during 1995–1997), and during the non-breeding season in 1996. The breeding season survey was carried out from November 1994 to March 1995, with roadside counts made from motorbike and other means of transport, searches at wetlands, and searches by boat. Colonies were also identified from information from local people, and from the literature (Saikia and Bhattacharjee 1989a,b, Saikia and Bhattacharjee 1990a,b, Barooah 1991). All 18 districts in the Brahmaputra valley in Assam were covered, except Sonitpur (Table 1). During the non-breeding season, we surveyed sites near slaughterhouses, garbage dumps and fish and meat markets in nine towns (Table 3). These sites were chosen because they were known to be

frequented by Greater Adjutants, or because this was reported by local people.

RESULTS

Greater Adjutants were found in seven districts only (Table 1). A total of 573 adjutants were counted during the breeding season: 470 foraging or resting and 103 at nest-sites. Of these, 432 were adults (21 of which were at nest-sites). We did not find any Greater Adjutants in North Lakhimpur district, but three were reported there in November 1994 (B. K. Talukdar and A. Choudhury verbally 1995). A total of 71 nests were found on 29 trees in five districts (Table 2). In 1996–1997, after the survey, we discovered two more colonies: eight nests at Satgaon (Mandakata) in Kamrup district and two at Maganapara (Bikrampur) in Sibsagar district. We omitted to visit Tezpur and Misamari, Sonitpur district during the breeding season, but found significant numbers of Greater Adjutants (53 and 17 respectively) during the non-breeding season in 1996. During the non-breeding season survey, 440 Greater Adjutants were counted, including 295 adults (Table 3). The largest numbers were in Guwahati city (200 birds).

Table 1. Breeding season counts of Greater Adjutants in the Brahmaputra valley during November 1994 to March 1995.

District	Foraging/resting		At nest	
	Adult	Young	Adult	Young
Lower Assam				
Dhubri	0	0	0	0
Kokrajhar	0	0	0	0
Bongaigaon	0	0	0	0
Goalpara	0	0	0	0
Barpeta	0	0	0	0
Nalbari	11	3	0	4
Kamrup	295	56	5	18
Darrang	0	0	0	0
Central Assam				
Morigaon	0	0	5	16
Nagaon	65	0	4	27
Upper Assam				
Golaghat	0	0	0	0
Jorhat	5	0	0	0
Sibsagar	32	0	7	17
Dibrugarh	0	0	0	0
Tinsukia	0	0	0	0
Dhemaji	0	0	0	0
North Lakhimpur	3	0	0	0
Total	411	59	21	82

Table 2. Nests and nesting trees in selected Greater Adjutant colonies in the Brahmaputra valley (NV= colony not visited; *= repeated visits during November 1994 to March 1995).

District	Colony	1994–1995			1995–1996			1996–1997		
		Date	Nest-trees	Nests	Date	Nest-trees	Nests	Date	Nest-trees	Nests
Nalbari	Daulasal	14 Feb 95	2	3	NV			NV		
Kamrup	Singimari	5 Feb 95	2	9	NV			NV		
	Dadara	5 Feb 95	3	8	26 Feb 96	4	15	NV		
	Satgaon	NV			27 Feb 96	2	7	3 Oct 96	2	8
Morigaon	Manaha	25 Mar 95	4	9	NV			19 Oct 96	5	19
Nagaon	Haibargaon	28, 29, 31 Mar 95	7	18	*			*		
	Khutikatia	31 Mar 95	1	5	*			*		
	Barpujia	26 Mar 95	2	5	29 Dec 95,	2	14			
					28 Feb 96	2	11	20 Oct 96	1	6
Sibsagar	Dichial	11, 13 Jan 95	4	6	NV			28 Nov 96	1	1
	Bagharchuk	12 Jan 95	4	8	NV			28 Nov 96	5	11
								6 Mar 97	5	8
	Maganapara	NV			NV			6 Mar 97	1	2

Table 3. Non-breeding season counts of Greater Adjutants in the Brahmaputra valley during June–July 1996.

Town	Site	Adults	Juveniles	Total	Remarks
Dibrugarh	Near slaughterhouse	7	3	10	Up to 20 in last three years. Locals report that population is declining.
Sibsagar	Near slaughterhouse	28	12	40	In two separate flocks
Jorhat	Garbage dump	2	1	3	10 km from possible nesting site at Nimatighat
Tezpur	Garbage and burial ground near fish- and meat market	45	8	53	Two different flocks
Misamari	Army butchery	17	0	17	Nesting area not known. Up to 30 reported.
Nagaon	Garbage dump	65	27	92	3 km from nesting colony
Guwahati	Garbage dump	118	82	200	
Rangia	Army butchery and fish-market	7	2	9	Two different flocks
Nalbari	Near fish-market	6	10	16	Local report that population is declining
Total		295	145	440	

DISCUSSION

Breeding population

Some birds may have been missed during the breeding season survey because our searches were concentrated along roads. However, some birds may have been counted more than once, as storks are highly mobile and can travel large distances fairly quickly. Saikia and Bhattacharjee (1989a) counted 300 Greater Adjutants and 75 active nests in Assam in 1989, but by 1994 this had risen to 649 birds and 157 active nests (Bhattacharjee and Saikia 1996). We counted 432 adults and 71 active nests during 1994–1995. The lower numbers are probably because we did not survey protected areas. Repeated visits within and between breeding seasons showed that Greater Adjutants do not breed highly synchronously. Hence, counting nests during single visits provides only a minimum estimate for the number of pairs breeding. We found Greater Adjutants in seven districts, whereas Bhattacharjee and Saikia (1996) reported them from 12 districts. We did not survey Sonitpur district and Kaziranga National Park in Golaghat district, nor other protected areas which were surveyed by them. Subsequently, we recorded a Greater Adjutant at Fakiragram in Kokrajhar district on 31 March 1997, and suggest there may be an as-yet undiscovered colony nearby. The nesting colony we discovered in Morigaon district had not previously been reported, and there may be additional colonies which are yet to be discovered. It is not known where the birds recorded in Jorhat and North Lakhimpur district breed (Bhattacharjee and Saikia [1996] also did not locate nesting colonies in these two districts during 1989–1994).

Non-breeding population

After breeding, adult and newly fledged juveniles move to regular feeding grounds in urban and semi-urban areas, such as garbage dumps, areas near slaughterhouses, and fish and meat markets. The total counted during the non-breeding season survey in 1996 was less than the total counted during the 1994–1995 breeding season, but this does not necessarily imply that the population had declined. The largest counts were in Guwahati city, where there is a huge garbage dump, fish and meat markets, and slaughterhouses. We counted a total of 440 Greater Adjutants in the non-breeding season, and extrapolate this to a total population estimate of 600 in the Brahmaputra valley. Hence the population appears to have been stable between 1994 and 1996.

Conservation

BirdLife International (2001) provided a comprehensive analysis of threats to this species, which are principally habitat loss and modification (of wetlands and nesting habitat), disturbance at nesting and feeding areas, persecution and pollution. In Guwahati, we were told by the local people that on one occasion, many Greater Adjutants died from 'contaminated food'. Occasionally adult Greater Adjutants were also found electrocuted. Almost all nesting colonies are found outside protected areas (see also Bhattacharjee and Saikia, 1996) where continuous protection by forest officials is not possible. There is widespread ignorance regarding the species. Only 30% of 49 people (of various age-groups, sex and educational qualifications) living near nesting colonies in different parts of Assam knew that this species is endangered and, within India, it breeds only in Assam. This lack of awareness among local people, and unfortunately also among many forest officials, hinders conservation of this bird.

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REFERENCES

Baruah, D. (1991) Greater Adjutant Stork nesting in upper Assam. *Newsletter for Birdwatchers* 31(1–2): 11.

Bhattacharjee, P. C. and Saikia, P. K. (1996) Conservation of Greater Adjutant Stork in Assam. Final Technical report. Unpublished WWF report.

BirdLife International (2001) *Threatened birds of Asia*. Cambridge, U.K.: BirdLife International.

Choudhury, A. (1994) Wildlife research in Assam: a review. Pp. 75–94 in Anon., *Proceedings of regional workshop on the coordination and monitoring of wildlife research*. Dehra Dun: Wildlife Institute of India.

Rahmani, A. R. (1989) Blacknecked and Greater Adjutant Storks in India. *ICBP/IWRB Specialist Group on Storks, Ibises and Spoonbills Newsletter* 2(1/2): 3–6.

Rahmani, A. R., Narayan, G. and Rosalind, L. (1990) Status of the Greater Adjutant Stork (*Leptoptilos dubius*) in the Indian subcontinent. *Colonial Waterbirds*. 13: 138–142.

Saikia, P. and Bhattacharjee, P. C. (1989a) Adjutant Storks at risk in Assam, India. *ICBP/IWRB Specialist Group on Storks, Ibises and Spoonbills Newsletter* 2(1–2): 6–8.

Saikia, P. and Bhattacharjee, P. C. (1989b). A preliminary survey of Adjutant Storks in Assam. *Asian Wetland News* 2(2):14–15.

Saikia, P. and Bhattacharjee, P. C. (1990a) Nesting records of Greater Adjutant Storks in Assam, India. *Specialist group on Storks, Ibises and Spoonbills Newsletter* 3(1–2): 2–3.

Saikia, P. and Bhattacharjee, P. C. (1990b) The present status of waders and other waterbirds of Brahmaputra Valley, Assam (India). *Stilt*. 16: 67–70.

Singh, R. L. (1991) Assam valley. Pp. 303–344 in Anon., *India: a regional geography*. Delhi: Geographical Society of India.

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